

In the Claims

The following Listing of Claims replaces all prior versions in the application:

LISTING OF CLAIMS

Claims 1-66. (Canceled).

67. (Previously presented) A device, comprising:

a sensor configured to output a sensor signal associated with one of a movement and a position of a housing to which the sensor is coupled;

an actuator coupled to the housing, the actuator being configured to output a rotary force based on a haptic feedback signal received from a processor, the haptic feedback signal being based on the sensor signal; and

a flexure having a plurality of flexible joints, the flexure being coupled to the actuator and the housing, the flexure being configured to translate the rotary force to a linear motion of the flexure, the flexure operative to output haptic feedback based on the rotary force.

68. (Previously presented) The device of claim 67, wherein the linear motion is substantially along an axis perpendicular to a base of the housing, the base being configured to contact a planar support surface.

69. (Previously presented) The device of claim 67, wherein the actuator includes an inertial mass, the inertial mass being configured to be moved linearly with the linear motion of the flexure, the haptic feedback including an inertial force.

70. (Previously presented) The device of claim 67, wherein a portion of the flexure is coupled to a moveable contact member, the movable contact member being configured to receive user input.

71. (Previously presented) The device of claim 67, wherein a portion of the flexure is coupled to a button coupled to the housing, the button configured to receive user input.

72. (Previously presented) The device of claim 67, further comprising:

a rotating member coupled to a rotating shaft of the actuator and to at least one flex joint from the plurality of flex joints.

73. (Previously presented) The device of claim 67, wherein the flexure includes a first arm member and a second arm member, the first arm member and the second arm member being configured to couple a linear moving portion of the flexure to a stationary portion of the flexure, the first arm member and the second arm member are coupled to the linear moving portion by at least one flex joint from the plurality of flex joints.

74. (Previously presented) The device of claim 67, wherein the flexure includes a central member, a first branch member and a second branch member, the central member of the flexure is coupled to a rotating shaft of the actuator, the first branch member and the second branch member arranged in a substantially Y-configuration.

75. (Previously presented) The device of claim 67, wherein the flexure includes a central member, a first branch member and a second branch member, the central member of the flexure is coupled to a rotating shaft of the actuator, the first branch member and the second branch member arranged in a substantially Y-configuration, at least one of the flex joints from the plurality of flex joints being disposed on each of the first branch member and the second branch member, at least one flex joint from the plurality of flex joints is disposed on the central member.

76. (Previously presented) The device of claim 67, wherein the flexure includes:

a rotating member coupled to the housing by at least one flex joint from the plurality of flex joints, and

a first arm member and a second arm member, the first arm member and the second arm member coupling the actuator to the housing by at least one flex joint from the plurality of flex joints.

77. (Previously presented) The device of claim 67, wherein the flexure includes:

a rotating member coupled to the housing by at least one flex joint from the plurality of flex joints, and

a first arm member and a second arm member, the first arm member and the second arm member coupling the actuator to the housing by at least one flex joint from the plurality of flex joints, the rotating member being coupled to the housing by a first flex joint and a second flex joint from the plurality of flex joints, the actuator being coupled to the housing by the first arm member and the second arm member, the first arm member and the second arm member including at least two of the flex joints from the plurality of flex joints.

78. (Previously presented) The device of claim 67, wherein the actuator is driven bi-directionally, the haptic feedback including at least one of a pulse and a vibration.

79. (Previously presented) The device of claim 67, wherein the flexure includes at least one stop to prevent motion of a shaft of the actuator past a desired portion of a full revolution.

80. (Previously presented) The device of claim 67, wherein the linear motion is associated with a graphical representation displayed by the processor, the sensor signal being associated with a position of a cursor displayed in the graphical representation.

81. (Previously presented) The device of claim 67, wherein the haptic feedback includes a pulse associated with a simulated interaction of a cursor with a graphical object displayed in a graphical user interface.

82. (Previously presented) The device of claim 67, wherein the haptic feedback includes a pulse associated with a simulated interaction of a cursor with a graphical object displayed in a graphical user interface, the pulse having a magnitude associated with a characteristic of the graphical object.

83. (Previously presented) The device of claim 67, wherein the haptic feedback includes a pulse associated with a simulated interaction of a cursor with a graphical object from a plurality of graphical objects displayed in a graphical user interface, the pulse having a magnitude associated with a type of the graphical object from the plurality of the graphical objects.

84. (Previously presented) The device of claim 67, wherein the haptic feedback includes a pulse associated with a simulated interaction of a cursor with an item in a graphical menu.

85. (Previously presented) The device of claim 67, wherein the haptic feedback includes at least one of a pulse, vibration, and texture force.

86. (Previously presented) The device of claim 67, wherein the sensor includes a ball that is configured to frictionally contact a surface over which the housing is movable.

87. (Previously presented) The device of claim 67, wherein the sensor is an optical sensor configured to detect a relative movement of the optical sensor with respect to a surface over which the housing is movable.

88. (Previously presented) The device of claim 67, wherein the actuator is positioned such that a rotating shaft of the actuator is configured to rotate about an axis substantially orthogonal to a base of the housing.

89. (Currently amended) A device, comprising:

a housing;

a sensor coupled to the housing, the sensor configured to output a sensor signal associated with one of a movement and a position of a the housing to which the sensor is coupled;

an actuator assembly including a stationary portion that is mounted to the housing and an actuator portion that is coupled to, and movable with respect to, the housing in response to said sensor signal, the actuator being configured to output a force based on the sensor signal; and

a mechanism including a flexure having at least a first flex joint and a second flex joint, the mechanism configured to couple the actuator portion of the actuator assembly to the housing such that movement of the actuator portion, ~~the actuator having a mass and being configured to~~ operates to provide haptic feedback to the housing in the form of an inertial force that is transferred to the housing by way of the stationary portion of the actuator assembly ~~as haptic feedback associated with the force,~~.

90. (Previously presented) The device of claim 89, wherein the actuator is configured to be moved in approximately a linear motion with respect to the housing.

91. (Previously presented) The device of claim 89, wherein actuator is configured to output a rotary force.

92. (Previously presented) The device of claim 89, wherein the actuator is configured to be moved in approximately a substantially linear motion, the linear motion being along a z-axis substantially orthogonal to an x-y plane, the device being configured to move in the x-y plane.

93. (Previously presented) The device of claim 89, further comprising a contact member, the actuator being coupled to the contact member, the contact member being configured to move with respect to the housing in response to the force output by the actuator, the contact member being further configured to receive an external input force.

94. (Previously presented) The device of claim 89, wherein the mechanism includes mechanical rotary bearings.

95. (Previously presented) The device of claim 89, wherein the flexure includes:
a rotating member coupled to the housing by at least the first flex joint, and
a first arm member and a second arm member each configured to couple the actuator to the housing by at least the first flex joint.

96. (Previously presented) The device of claim 89, wherein the flexure includes at least one stop to prevent rotation of a shaft of the actuator past a desired portion of a full revolution.

97. (Previously presented) The device of claim 89, wherein the actuator is configured to move bi-directionally to output at least one of a pulse and a vibration.

98. (Previously presented) The device of claim 89, wherein the haptic feedback is associated with a graphical representation displayed by a processor, a position of the housing in a planar workspace being associated with a position of a cursor displayed in the graphical representation.

99. (Previously presented) The device of claim 89, wherein the haptic feedback is a pulse associated with the simulated interaction of a cursor with a graphical object displayed in a graphical user interface.

100. (Currently amended) A method, comprising:

~~sending-generating~~ a sensor signal associated with one of a movement and a position of an interface device; and

imparting haptic feedback to a housing of the interface device ~~outputting via by way of an~~ actuator assembly ~~haptic feedback based on the sensor signal, the actuator~~ having a stationary portion that is rigidly mounted to the housing and a movable actuator portion that is movable with respect to the housing in response to the sensor signal, the movable actuator portion being coupled to the housing by way of ~~being coupled to a housing of the interface device via a~~ flexure, ~~the flexure~~ having at least one flex joint, ~~the flexure being configured to couple the~~ actuator to the housing.

101. (Previously presented) The method of claim 100, wherein the haptic feedback is associated with a haptic feedback signal received by the interface device from a processor.

102. (Previously presented) The method of claim 100, wherein the actuator is moved in approximately a linear motion.

103. (Previously presented) The method of claim 100, wherein the haptic feedback output by the actuator is associated with a rotary motion of the actuator.

104. (Previously presented) The method of claim 100, wherein the actuator is moved in approximately a linear motion along a z-axis substantially orthogonal to a base of the housing.

105. (Currently amended) An apparatus configured to be coupled to an interface device to thereby provide haptic feedback to the interface device in response to a control signal, the apparatus, comprising:

an actuator having an actuator mass, an actuator housing and a rotating shaft, ~~the actuator housing being configured to be coupled to, and movable with respect to, a housing of an interface device, the actuator having a mass and being configured to output an inertial force; and~~

a flexure mechanism coupling the actuator housing to the interface device by way of including at least one flex joint enabling relative motion between the actuator and the interface device in response to rotation of the rotating shaft caused by said control signal, said relative motion imparting an inertial force to the interface device to thereby provide said haptic feedback;
~~a movement of the actuator being associated with a haptic feedback and based on the inertial force.~~

106. (Previously presented) The apparatus of claim 105, wherein the actuator moves approximately linearly.

107. (Previously presented) The apparatus of claim 105, wherein the inertial force output by the actuator is a rotary force.

108. (Previously presented) The apparatus of claim 105, wherein a rotating shaft of the actuator is coupled to a flexure arm including the at least one flex joint, the flexure arm being configured to be coupled to a portion of the interface device housing, the interface device housing being flexibly coupled to a carriage, the carriage being coupled to the actuator housing.

109. (Previously presented) The apparatus of claim 105, wherein the flexure mechanism includes a travel limiter configured to limit the movement of the actuator within a desired range of motion.